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EXHIBIT A

CONCEPTION FROM URIBE NOTEBOOK

Table 1. RCA Type II Catalyst Performance Measured as Voltage Loss at 0.6 A/cm^2. Fuel composition: 100 ppm CO/H_2 + air bleed.

Cell ID	Page in notebook	Material	Source	Load mg/cm^2	mV (4%air)	mV (6%air)
TF 385	145	Sn	Janssen	0.72	150	105
TF 361	131	Mo	Alfa Aesar	1.00	125	70
TF 365	129	Cu cat	Engelhard	1.30	43	36
TF 353	123	CuO (a)	Alfa Aesar	1.87	55	25
TF 362	121	W	Johnson Matthey	1.30	75	25
TF 359	128	Cu	Alfa Aesar	4.00	45	25
TF 389	149	TbOx(III,IV)	Alfa Aesar	0.72	30	22
TF 345	120	CuO	Johnson Matthey	1.47	30	20
TF 356	127	CuO (ac)	LANL prepared	0.79	35	10
TF 373	140	Fe_2O_3	Alfa Aesar	0.32	22	9
TF 372	141	CoOx(II,III)	Johnson Matthey	0.72	44	8
TF 357	126	CuO/ZnO	United Catalysts	1.82	35	5

EXHIBIT B

TABLE OF EXPERIMENTS AND RESULTS

(Reduction to Practice)

30 July 97

Backing with Pt
Ink F-22-97 (Book of inks)
Dry ink : 18.2 % Pt (For 5 cm² cells)

Backing surface : 9.6 cm²

Amount sought for 0.3 mg Pt/cm² (dry ink) = 15.8 mg
Actual amount :

Note : This ink appears to have too much Teflon. Not used any more

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New ink for backings. 30 July 97

0.7017 g 20% Pt on Vulcan XC-72 (ETEK)
3.5 ml "Teflon 120" suspension (0.02 g solid/ml)
0.840 g glycerol
5.0 ml isopropanol
2.0 ml di-water

- Sonication for 10 min.
- Bar stirring for 12 hrs. (overnight)

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10 Sept. 97

Use of non-precious metals catalysts on the backing :

Idea : Improve CO-tolerance with air bleeding using non-precious metal based catalyst
Ex : WC, metal oxides

Ink preparation : next page

/reviewed by Fernando Garzon 10/29/97/

EXHIBIT C

FUEL CELL ANODE INK COMPOSITIONS FROM URIBE NOTEBOOK

WC ink preparation — 18 Sept 97

0.4015	g	WC	85%
0.0344	g	C-black (Vulcan XC72)	7%
0.476	g	glycerol	
1.0	ml	isopropanol	
1.9	ml	"Teflon 120" suspension (0.02 g solid/ml)	8%

- 10 min sonication
- bar stirred overnight

Dry ink: WC: 85% ; Teflon: 8%; C black = 7%

Backing: standard ETEK carbon cloth
A: 9.6 cm²
Total dry ink (WC 18-Sep-97) = 27.3 mg

mgWC/cm² = 2.42
Ink used in cell TF 343
Remet:

Cu (II) oxide ink preparation — 24 Sept 97

			Dry ink
0.4000	g	CuO (Puratronic, JMC)	85%
0.0342	g	C-black (Vulcan XC72)	7%
0.4809	g	glycerol	
1.9	ml	"Teflon 120" suspension (0.02 g solids/ml)	8%
1.0	ml	isopropanol	

- 10 min sonication
- bar stirred overnight

TF 345: Effect of CuO (on backing) on CO tolerance:
- Two layers of ink painted on a (3.15)² cm² ETEK (uncatalyzed) backing: dry ink = 16.9 mg*
(Sintered @ 280°C for 15 min)

(1) CuO = 1.45 mg/cm² used in cell TF 345
Remet: This cell showed full tolerance to 100 ppm CO with 4-5% Air bleeding.

9/25/97

WC backing layer sintered under Ar

Backing weights (after heating at 280°C for 15 min)
Cloth size: 3.15 × 3.15 cm² = 9.92 cm²

0. 0.2322 g
1. 0.2309 g
2. 0.2339 g

Painting ink
0. 2 layers painted
1. 3 " "
2. 2 " "

Weights after painting & heating @ 280°C for 20 min under Ar

		mg WC/cm²	
0. 0.2503	0.0181	1.7	used in TF-344
1. 0.2471	0.0162	1.4	
2. 0.2497	0.0158	1.4	

W backing layer

10/1/97

0.4000 g W (JM Alfa, Puratronic)
0.0344 g C black (Vulcan XC72)
0.546 g glycerol
1.9 ml "Teflon 120" suspension (0.02 g solids/ml)

- Sonication for 10 min
- Bar stirred overnight

= Various layers of the ink painted on a ETEK unacatalised cloth (air dry inbetween layers)
= sintered @ 280°C for 15 min
W content = 1.3 mg W/cm²

Used in FC: TF 362 A: 0.15 mg Pt/cm²
C: 0.17 mg Pt/cm²

CuO Alfa ultrapure 14-Oct 97

Ink preparation

0.4003 g CuO (85% dry ink)
0.0341 g C-black (Vulcan XC-72) (7%)
0.509 g glycerol
1.90 ml "Teflon T20" suspension (0.02 g solids/ml) (8%)

10 min. sonication
Bar stirred overnight

Backing preparation 15 oct 97

Uncat. ETEK blank = 0.2267 g (9.92 cm²)
" + (Cu/C/Teflon) = 0.2485 g (*)

(*) sintered @ 280°C for 15 min)

CuO = ~~2.5~~ 1.87 mg/cm²

Used in TF 353

CuO + ZnO (G66B) Catalyst

Ink preparation:

0.4005 g CuO-ZnO (G66B, 200 mesh)
0.0350 g C-black (Vulcan XC-72)
0.4215 g glycerol
1.9 ml "Teflon 120", suspension (0.02 g solids/ml)

- Sonicated for 10 min
- Bar stirred overnight

G66B Composition %

CuO : 33
ZnO : 65
Al_2O_3 : <2

Dry ink composition

G66B : 84.6 %
C-black : 7.4 %
Teflon : 8.0 %

For TF 357 backing

blank (E-TEK) = 0.2231 g
+ dry ink (280°C) = 0.2445 g
0.0214 g

G66B = 1.82 mg/cm²
CuO = 0.60 mg/cm²

Result: Full CO (100 ppm) tolerance with 6% Air bleeding

Backing preparation for FC : TF356
CuO (from acetate; ink 10/22/97 page 125)

E-TEK blank = 0.2253 g (standard)
(non catalized, heated @ 280 °C for 15 min)
+ dry ink = 0.2396 g

CuO(acetate) : 0.79 mg CuO/cm^2

Result : Full Tolerance to 100 ppm CO + 6 % air
File : FCOCT97 Run 395 & 378

3NOV97

Backing preparation for FC : TFC 358

CuO (from acetate, ink 10/22/97 page 125)

E-TEK blank (standard) = 0.2284 g
(heated @ 280°C for 15 min)

blank + dry ink = 0.2489 g (15% CuO)

dry ink = 20.5 mg

CuO (acetate) = 1.14 mg/cm^2

Used in FC : TF358

Result : Poor tolerance to 100 ppm CO

4 Nov 1997

Preparation of ink catalyst containing Cu (metal) for CO tolerance with air bleeding in H_2/Fuel Cells

		Dry ink
Cu* (Alfa) powder	= 0.4002 g	85 %
C. black (Vulcan XC-72)	= 0.0344 g	7 %
Glycerol	= 0.3907 g	8 %
"Teflon 120" suspension (0.02 g solids/ml)	= 1.9 ml	
Isopropanol	= 1.0 ml	

*(Cu (Alfa) : -325 mesh)

- Sonicated for 10 min
- Bar stirred overnight

* A foamy ink resulted.

Backing preparation for FC : TF 359

E-TEK (standard) blank = 0.2072 g
+ Cu/C/Teflon ink = 0.2538 g
(after sintering @ 280°C for 15 min)

dry ink = 0.0466 g

4.0 mg Cu/cm^2

5 Nov 97

Ink preparation with Cu-catalyst (Engelhard) * for backing

(This catalyst is used for purifying glove boxes)

0.4000 g Cu-cat. (powdered in a mortar)
0.0340 g C-black (Vulcan XC-72)
0.4094 g glycerol
1.00 ml isopropanol
1.9 ml "Teflon 120" suspension (0.02 g solids/ml)

- Sonicated for 10 min
- Bar stirred overnight

Backing preparation

E-TEK std blank : 0.2339 g
+ dry cat. ink : 0.2542 g

0.0203 g

2 mg catalyst/cm²

* Engelhard : Cu-0226 S14×20
(Cu catalyst)
Prod Code 053724 00100

Test on FC : TF365

6NOV97

Backing with Mo

Mo-powder (Alfa products) -100 mesh

Ink preparation:

0.4000 g Mo
0.0342 g C-black (Vulcan XC-72)
~~0.4295 g glycerol~~
0.4348 g glycerol
1.9 ml "Teflon 120" suspension (0.02 g solids/ml)
1.0 ml isopropanol

- Sonicated for 10 min
- Bar stirred overnight

(*)

Backing preparation

Backing E-TEK std. = 0.2336 g
+ Mo ink (280°/15min) = 0.2452 g
Dry Mo ink 0.0116 g

Mo: 1.0 mg/cm^2

Used in cell TF 361

Anode Backing with Fe_2O_3 #1 — 12 Dec 97

For cell TF373 — Dry ink

0.2004 g Fe_2O_3 (Alfa) — RS

0.0174 g C-black Vulcan XC72 — 7

0.2141 g glycerol

0.950 ml 6% Teflon 120" suspension (0.02 g solids/ml)

0.5 ml isopropanol

- 10 min sonication
- Ba stirred over the weekend

Backing:

blank = 0.2284 g

+ ink = 0.2321 g

3.7 mg

0.32 mg Fe_2O_3/cm^2

Used in TF373

Cell TF 380 — 18 March 98

Anode Backing with $LaCoO_3$ (from Fernando G)

Ink preparation:

	Dry Ink %
0.2001 g $LaCoO_3$	85
0.0170 g Vulcan XC 72R	7
0.3202 g glycerol	
950 µL "Teflon 120" suspension (0.02 g solids/ml)	8
0.5 ml isopropanol	

- Sonicated for 10 min
- Bar stirred overnight

Blank : 0.1978
+ La_2CoO_3 ink : 0.2120
Dry ink : 0.0142

1.22 mg $LaCoO_3/cm^2$
used in TF 380

Cell TF 385 — 18 March 98

Anode Backing with Sn (Janssen)

Ink preparation

	Dry ink
0.1003 g Sn powder	70 %
0.0311 g Vulcan XC 72R	22 %
0.3422 g glycerol	
575 µL "Teflon 120 suspension (0.02 g solids/ml)	8 %
0.5 ml isopropanol	

- Sonicated for 10 min
- Bar stirred overnight

Blank : 0.1897 g
+ Sn ink : 0.1972 g
dry ink : 0.0075 g

0.53 mg Sn/cm^2 : Used in cell TF 385

Anode Backing with: Terbium (III,IV) Oxide

		% Dry ink
0.2000 g	TbOx	85
0.0173 g	C-black Vulcan XC72	7
0.222 g	glycerol	
950 µL	"Teflon 120" suspension (0.02 g solid/ml)	8
0.5 ml	isopropanol	

- 10 min sonication
- Ba stirred overnight

TF389

blank : 0.2417 g
+ dry ink : 0.2501 g

Dry ink : 0.0084 g

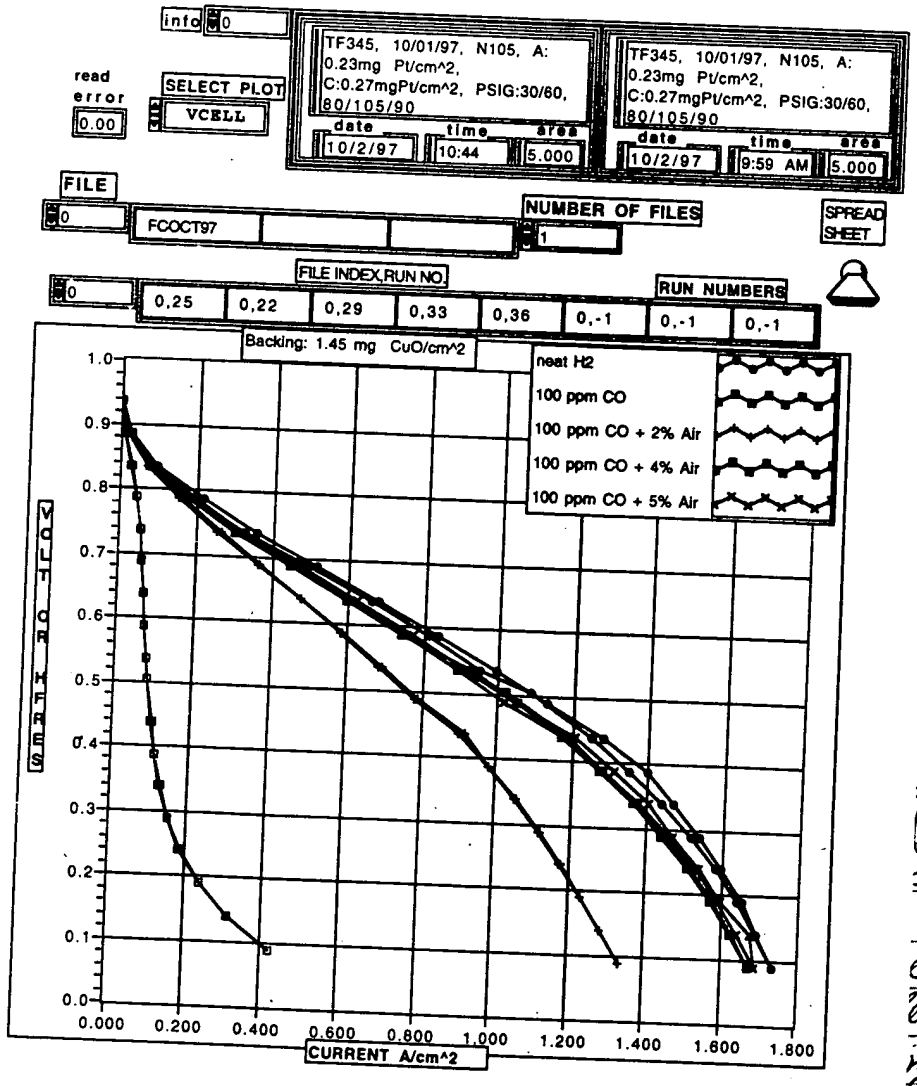
0.72 mg Tb (III, IV) Oxide

EXHIBIT D

EXEMPLARY FORM OF TEST DATA FROM URIBE NOTEBOOK

WE ink preparation

18 Sept



85°

2) 7°

2g solid/m

; Cblack = 7

oth

ng

24 Sept

D

JM() 85

7

g solids/ml

0 tolerance

$(3.15)^2 cm^2$

= 16.9 mg*

ell TF345

erance to 100 ppm

ng.

EXHIBIT E

LABORATORY TEST STATION LOG BOOK PAGES

TF 345 Station 3 N105/A: 0.23 mg Pt/cm² / C: 0.27 mg Pt/cm²
10-1-97
Backing: 1.45 mg CuO/cm²

date/time	Cd	Vcell	Fr	PSIG	Tc/Th/Th
10-2 8:10	5.47	0.5	160/550	30/60	80/105/90
8:11	SRG: 10.79, HFR: 0.147				OCV: 0.97
9:05	100 ppm CO	H2: 158, CO: 1.6 sccm			
10:00	CO off.				
10:50	100 ppm CO + 2% Air				
11:40	CO & Air off				
~~12:16~~ 12:25	100 ppm CO + 4% Air				
13:18	CO & Air off				
2:10pm	100ppm Co + 5% air				
Shuting down ~~test~~ test complete					

TF 345 Station 3 N105/A: 0.21 mg Pt/cm² / C: 0.24 mg Pt/cm²
10/2/97
Backing: 1.9 mg CuO/cm²

10-3 8:37	6.41	0.5	160/550	30/60	80/105/90
SRG: 10.81	HFR: 0.127		OCV: 0.99		

TF 345 St. 3
10/6 6:10 Cell re-assembled and new test started.

9:03	3.87 A	0.5	160/550	30/60	80/105/90
SRG: 10.77	HFR: 0.163		OCV: 0.99		
10/7 8:16	4.57	0.5	160/550	30/60	80/105/90
8:18	SRG: 10.82	0.171		OCV: 0.99	

TF353 Station 5 N105 | A: 0.17 mg Pt/cm²
10/22/97 | C: 0.19 mg Pt/cm²
Backing: Anode: ~~1.87 mg/cm²~~ CuO_2, Cathode: Std E-TEK

date/time		Cd	Vcell	Fr	PSIG	Tc/Th/Th
10/23	8:25	6.88	0.5	160/550	30/60	80/105/90
	8:32	SRG: 13.06	HFR: 0.103		OCV: 0.97	
	9:30	CO on (100 ppm)				
	10:21	CO off.				
	11:03	6.50	0.5			
	11:37	CO on (100 ppm) Air on 2%				H_2: 144, CO: 16, Air: 3
	12:30	CO + air off				
	1:37	100 ppm CO + air 4%				
	2:33	CO off				
	3:33	100 ppm CO + air 6% (9.6)				(H_2, CO, Air: 140, 16, 9.6)
	4:20	CO & Air off.				
10/24	8:01	6.69	0.5	160/550	30/60	80/105/90
	8:02	SRG: 13.03, HFR: 0.107			OCV: 0.97	
	8:50	100 ppm CO + 6% air				
	9:43	CO off - Raise H_2 Humid temp: 120C				
	~~10:45~~	~~100 ppm CO~~				
	11:40	CO off				
	1:45	100 ppm CO + 6% air T_{H_2}: 120C				
10/27	8:18	6.65	0.5	160/550	30/60	80/105/89
	8:19	SRG: 13.02	HFR: 0.108		OCV: 0.97	
	~~8:45~~	H_2 ~~flow~~: 80 sccm				
	10:30	100 ppm CO H_2: 7.2 CO: 8.0				
	11:20	CO off				
	1:10	100 ppm CO + 2% air				
	2:13	CO off				
	3:05	100 ppm CO + 4% air				
	4:00	CO off				
10/28	8:12	6.53	0.5	160/550	30/60	80/105/90
	8:19	SRG: 12.98	HFR: 0.108		OCV: 0.98	
	8:55	100 ppm CO + 6% air				
	9:45	CO + air off				

Cont on Ps 115

TF35-6 Station 3 N105 / A: 0.17 mg Pt/cm² / C: 0.18 mg Pt/cm²
10/29/97
Backing / A: 0.79 mg Cw O/cm², C: Std E-TEK

date/time		Cd	Vcell	Fr 700	PSIG	Tc/Th/Tg
10/30	8:10	6.83	0.5	160/~~700~~	30/60	80/105/90
	8:14	SRG: 10.94	HFR: 0.104		OCV: 0.97	
	8:45	100ppm CO				
	9:44	CO off				
	10:40	100ppm CO + 2% air				
	11:30	CO off				
	1:30	100ppm CO + 4% air				
	2:20	CO off				
	3:07	100ppm CO + 6% air				
	4:00	CO off				
10/31	8:12	5.67	0.5	160/~~700~~	30/60	80/105/90
	8:20	SRG: 10.94	HFR: 0.103		OCV: 0.99	
	9:20	100ppm CO + 6% air				
	9:22	6.21	0.5			
	11:20	6.31 A	0.5 V	Start a life test w/ 100ppm CO + 6% air		
1.40 hrs	12:40	10.40	0.5	- CO + air off		
2.69	2:04	7.34	0.5	CO on 100ppm		
3.18	2:30	0.39	0.5	6% air on		
4.87	4:13	6.45	0.5	CO + air off		
	4:18	H_2 flow to: 80 sccm				
	4:50	7.70	0.5	80/700	30/60	80/105/90
11/3	8:22	4.97	0.5	80/700	30/60	80/105/90
	8:31	SRG: 10.93	HFR: 0.104		OCV: 0.97	

Removing from station - for new test

TF3531 station 5 Cont from pg 112

date/time	Cd	Vcell	fg	PSIG	Tc/H2/Th
10/29 8:31	6.52	0.5	80/~~550~~	30/60	80/105/90
8:34	SRG: 12.96	HFR: 0.109		OCV: 0.98	
10/30 8:11	6.45	0.5	80/~~550~~	30/60	80/105/90
8:15	SRG: 12.95	HFR: 0.109		OCV: 0.98	
10/31 8:15	6.38	0.5	80/550	30/60	80/105/90
8:19	SRG: 12.99	HFR: 0.108		OCV: 0.98	
4:13	6.45	0.5	80/550	30/60	80/105/90
~~4:20~~	~~H2~~				
11/3 8:30	6.35	0.5	80/550	30/60	80/105/90
8:32	SRG: 12.90	HFR: 0.109		OCV: 0.98	
11/4 8:00	6.41	0.5	80/550	30/60	80/105/90
8:03	SRG: 12.89	HFR: 0.109		OCV: 0.98	
9:30	no H2 flowing thru MKS controller - chgd back to Rotometer @ 160 sccm				
11/5 8:07	6.26	0.5	160/550	30/60	80/105/90
8:09	SRG: 12.87	HFR: 0.112		OCV: 0.98	
10:40	MKS controller checked - everything OK - switched to reformate set H2 @ 80 sccm				
11/6 8:25	6.07	0.5	80/550	30/60	80/105/90
8:34	SRG: 12.87	HFR: 0.114		OCV: 0.98	
3:12	6.04	0.5	80/550	30/60	80/106/90

Shutting down Station to replace Cell - Testing Compete

[redacted]

TF-357 Station 3 N105 | A: 0.19 mg Pt/cm²
11-3-97 | C: 0.23 mg Pt/cm²
Backing | A: 1.82 mg G66B/cm², C: Std - E-TEK
air set 45 ≈ 55sccm

date/time	Cd	Vcell	Fr	PSIG	Tc/Th/Tn
11/4 ~~9:59~~	5.35	0.5	160/550	30/60	80/105/90
wrong pg ~~8:01~~	~~SRG: 14.25~~	~~HFR: 0.173~~		~~OCV: 0.99~~	
8:02	SRG: 10.93	HFR: 0.108		OCV: 0.97	
8:35	100ppm CO				
9:23	CO off				
9:20	100ppm CO + 2% air				
11:15	CO off				
12:15	100ppm CO + 4% air				
1:06	CO off				
2:00	100ppm CO + 6% air				
2:55	CO off				
3:40	T_{H_2}: 120°C				
4:30	100ppm CO + 6% air				
11/4 8:06	5.81	0.5	160/550	30/60	80/105/90
8:08	SRG: 10.92	HFR: 0.107		OCV: 0.97	
8:33	T_{H_2}: 120°C				
9:30	100ppm CO + 4% air @ 120°C T_{H_2}				
10:40	CO off				
10:45	100ppm CO @ 120°C				
1:00	Removed from Station				
	test complete				

[redacted]

TF359 Station 5 N105/A 0.18 mg Pt/cm²
11/6/97 C: 0.22 mg Pt/cm²
Backing/A: 4 mg Cu/cm², C: Old E-TEK uncat.

date/time	Cd	Vcell	Fr	PSIG	Tc/Th/Th
11/7 8:05	6.65	0.5	160/550	30/60	80/105/90
8:08	SRG: 12.86	HFR: 0.111			OCV: 0.97
~~8~~ 8:50	100 ppm CO of 0.1% CO in H_2				($\frac{H_2}{140}$ · $\frac{CO}{16.0}$)
10:45	CO off				
1:15	100 ppm + 2% air				
2:10	CO off				
3:03	100 ppm CO + 4% air				
~~3~~ 3:50	CO off				
11/10 8:16	5.66	0.5	160/550	22/60	80/105/90
8:21	SRG: 12.83	HFR: 0.121			OCV: 0.97
8:50	100 ppm CO + 6% air				
9:50	CO off				
10:48	~~temp~~ Chgd H_2 temp: 120°C				
11:35	100 ppm CO				
12:20	CO off				
1:33	100 ppm CO + 6% air				
2:52	CO off				
11/12 8:06	5.26	0.5	160/550	30/60	80/105/90
8:09	SRG: 12.19	HFR: 0.119			OCV: 0.97

Shutting cell down - removing from station

TF361 Station 5 N105/A: 0.15 mg Pt/cm²
11/13/97 C: 0.15 mg Pt/cm²
Anode Back: 1.0 mg Mo/cm², Cathode: Std E-TEK

date/time		Cd	Vcell	Fr	PSIG	Tc/Th	Th
11/14	8:12	5.47	0.5	160/70	30/60	80/105	/90
	8:17	SRG: 12.75, HFR: 0.104				OCV: 0.97	
	8:48	100 ppm CO		H_2: 144	CO: 16.0		
	9:43	CO off					
	10:40	100 ppm CO + 2% air		H_2: 144	CO: 16.0	Air 3.2	
	11:37	CO off					
	12:30	100 ppm CO + 4% air					
	~~1~~ 36	CO off					
	2:36	100 ppm CO + 6% air					
11/17	2:05	5.26	0.5	160/550	30/60	80/105	/90
	2:05	SRG: 12.72	HFR: 0.107			OCV: 0.97	
	2:01	Th(H_2) = 120°C					
	3:54	100 ppm CO On					
	4:45	CO off					
	6:30	CO (100 ppm) + 6% Air on					
	7:26	CO & Air off ; Th(H_2) = 105°C					
11/18	8:59	4.90	0.5	160/550	30/60	80/105	/90
	8:02	SRG: 12.72	HFR: 0.106			OCV: 0.97	

Removed from Station - Test Complete!

TF-362 Station 5 N105/A: 0.15 mg Pt/cm²
11/18/97 C: 0.17 mg Pt/cm²
Anode Batching: 1.3 mg W/cm²

date/time	Cd	Vcell	FR	PSIG	Tc/Th/Ta
11/19 8:00	6.59	0.5	160/550	30/60	80/105/90
8:25	SRG: 12.71	HFR: 0.121			OCV: 0.97
9:15	100 ppm CO (0.1%)	(H_2: 144, CO: 16.0 sccm)			
10:30	CO off				
11:25	100 ppm CO + 2% air	(H_2: 144, CO: 16.0, Air: 3.2) sccm			
12:25	CO off				
1:30	100 ppm CO + 4% air				
2:20	CO off				
3:18	100 ppm CO + 6% air				
4:05	CO off				
11/20 8:00	6.64	0.5	160/550	30/60	80/105/90
8:09	SRG: 12.67	HFR: 0.126			OCV: 0.98
8:30	T_{H_2}: 120°C				
9:30	100 ppm CO on				
10:21	CO off				
1:38	100 ppm CO + 6% air				
2:30	CO off				
3:20	PSIG: 30/30,	Tc/T_{H_2}/Tair 80/105/90,			80/550 sccm
11/21 8:15	5.80	0.5	80/550	30/30	80/105/90
8:22	SRG: 12.72	HFR: 0.131			OCV: 0.97
8:50	100 ppm CO	(H_2: 72, CO: 8.0)			
9:45	CO off				
12:50	100 ppm CO + 2% air				
1:40	CO off				
11/24 8:06	5.88	0.5	80/550	30/30	80/105/90
8:10	SRG: 12.73	HFR: 0.119			OCV: 0.97
9:00	100 ppm CO + 4% air				
9:55	CO off				
~~10:45~~	~~Open Circuit Voltage~~	Wrong entry			
11:00	100 ppm CO + 6% air				
1:00	CO off				

cont on Pg 129

#F362 Pt. 5 cont fm pg 125

date/time	Cd	Rcell	Fr	PS/G	TC/Th/Th
11/25 8:47	5.95	0.5	81/550	30/30	80/105/90
9:05	SRG: 12.45	HFR: 0.124			OCV: 0.97
11:03	H_2 + 25% CO_2		H_2: 80		CO_2: 27
11:55	CO_2 off				
1:00	25% CO_2 + 100 ppm CO				
1:51	CO_2 & CO off				
3:12	25% CO_2 + 100 ppm CO + 6% air				
4:15	CO_2 & CO off				
4:29	Air off				
5:30	5.85 Amp 0.5 V. Shut down				

Removed from station

~~Cell performance was never very good. did not improve.~~ entered on wrong pg (JH)

~~#F364 Station 3 cont fm pg 128~~

~~1:10 100 ppm CO + 2% air~~

~~2:00 CO off~~

~~2:50 100 ppm CO + 4% air~~

~~3:40 CO off~~

~~12/11 8:10~~	~~6.10~~	~~0.5~~	~~H_2 + Air 80+0.5~~	~~550~~	~~30/80~~	~~80/105/90~~
~~8:18~~	~~SRG: 10.99~~	~~HFR: 0.100~~			~~OCV: 0.99~~	
~~12/12 8:48~~	~~6.88~~	~~0.5~~	~~80~~	~~550~~	~~30/60~~	~~80/105/90~~
~~8:51~~	~~SRG: 10.95~~	~~HFR: 0.103~~			~~OCV: 0.99~~	

~~Removed from station~~

TF365 Station 5 N105/A: 0.18 mg Pt/cm²
12/1/97 C: 0.19 mg Pt/cm²
Anode Back: 2.0 mg Engelhard Cow-cat/cm²

date/time	Cd	Vcell	FR	PSIG	Tc/Tn/Th
12/2 8:48	3.84	0.5	160/550	30/60	80/105/90
8:51	SRG: 12.82	HFR: 0.204			OCV: 0.97
12/3 10:01	4.09	0.5	80/550	30/60	80/105/90
10:12	SRG: 12.70	HFR: 0.202			OCV: 0.97
2:30	100 ppm CO				
3:20	CO off				
4:22	SRG: 12.8 (set)	HFR: 0.209			
4:40	HFR: 0.209	i = 4.08			$T_{h(H_2)}$ = 105
		V = 0.6			
4:40	$T_h(H_2)$ = set @ 120 °C				
5:20	" = 120;	i = 0.42	V = 0.5		
	SRG = 12.8 (set);	HFR = 0.168			
5:22	$T_h(H_2)$ set @ 105 °C				
12/4 7:58	3.96	0.5	80/550	30/60	80/105/90
8:04	SRG: 12.70	HFR: 0.200			OCV: 0.98
8:49	100 ppm CO + 2% air				
9:37	CO off				
10:20	100 ppm CO + 4% air				
11:02	CO off				
11:55	100 ppm CO + 6% air				
12:55	CO off				

Cell removed from station.
Cell performance was poor and did not improve

~~TF369~~ Cont from pg 139 Station 3

~~1/14 10:40 394 0.5 160/550 30/60 80/105/90~~
float is at 9 or 0.9
Removed from station performance deteriorated did not recover
~~When disassembled a small amount of material~~ was lodged in flow field of anode. Reassembled and current came up to 9.6A at 0.5V ~~inserted~~ air at 6% for 10 min ≈ 5.24A @ 0.5V
1/15 Replaced with new cell

TF372 Station 3 N105 | A: 0.17 mg Pt/cm²
1/20/98 | C: 0.18 mg Pt/cm²
Backing: Anode: 0.72 mg CO/cm², Cathode: std ETEK

date/time	Cd	Vcell	Fr	PS16	Tc/Tp/Th
1/21 7:55	5.07	0.5	160/550	30/60	80/105/90
8:01	SRG: 11.08	HFR: 0.106		OCV: 0.95	
9:14	100 ppm CO,	10:00 CO off			
11:50 ~~11:55~~	100 ppm CO + 2% air				
1:10	CO off				
2:10	100 ppm CO + 4% air				
3:00	CO off				
3:45	100 ppm CO + 6% air				
4:25	CO off				
1/22 8:03	6.76	0.5	160/550	30/60	80/105/90
8:29	SRG: 11.05	HFR: 0.105		OCV: 0.97	
1:55	H_2 flow: 80 sccm				
1/23 8:05	6.96	0.5	80/550	30/~~60~~	80/105/90
8:13	SRG: 11.07	HFR: 0.104		OCV: 0.97	
10:42	Reformate on 200 sccm				
11:40	Reform off				
12:30	~~100~~ Reformate + 2% air				

cont on Pg 145

TF372, St. 3 Cont from pg 143
1/20/90

date/time	Cd	Vcell	Fr	PSIG	Tc/Tn/Th
1/23 1:25	Reformat off				
2:30	Reformat @ 200sccm + 4% air				
3:20	Reformate off				
4:10	Reform @ 200sccm + 6% air				
4:48	Reformate off				
1/26 7:56	6.41	0.5	80/550	30/60	80/105/90
8:09	SRG: 11.09	HFR: 0.103			OCV: 0.97
10:05	H_2 temp = 120 C				
10:47	6.55	0.5	80/550	30/60	80/120/90
	SRG: 11:09	HFR: 0.098			OCV: 0.97
11:10	100 ppm CO on				
11:55	CO off				
1:00	Cell did not recover after 1 hr of CO being off turned on air purge @ 6%				
1:10	air off				
1:30	100ppm CO + 2% air				
2:15	CO off air left on				
3:05	100ppm CO + 6% air				
3:50	CO off Hi temp decreased to 105				
1/29 7:58	5.97 off	0.5	80/550	30/60	80/105/90
8:27	SRG: 11.08	HFR: 0.098			OCV: 0.95
9:55	Reformate: 200sccm				
~~1:45~~	Ref. off				
1:15	Ref + 2% air				
2:00	Ref off				
3:00	Ref + 4% air				
3:45	Ref off				
1/30 8:05	6.16	0.5	80/550	30/60	80/105/90
8:17	SRG: 11.09	HFR: 0.099			OCV: 0.95
8:55	Ref + 6% air				
9:48	Ref off				

Cont on pg 148

TF373 Station 5 N105/A: 0.2 mg Pt/cm²
1/26/98 C: 0.21 mg Pt/cm²

Backing: A: 0.32 mg Fe_2O_3/cm², C: Std E-TEK

date/time	Cd	Vcell	Fr	PSIG	Tc/Th/Th
1/29 8:21	5.09	0.5	160/550	30/60	80/105/90
8:30	SRG: 12.70, HFR: 0.104				OCV: 0.97
9:55	100 ppm CO (H_2: 144, CO: 0.19% 16.0)				
11:00	CO off				
1:15	100ppm CO + 2% air				
2:00	CO off				
3:00	100ppm CO + 4% air				
3:45	CO off				
1/30 8:07	5.73	0.5	160/550	30/60	80/105/90
8:19	SRG: 12.73	HFR: 0.103			OCV: 0.98
8:55	100ppm CO + 6% air				
9:50	CO off				
10:55	H_2 flow at 80 sccm				
2:40	Reformate: 200 sccm				
3:45	Ref. off				
2/2 8:15	5.49	0.5	80/550	30/60	80/105/90
8:30	SRG: 12.73,	HFR: 0.102			OCV: 0.98
9:45	200sccm Reformate + 2% air				
10:40	Ref off				
11:50	200sccm Reformate + 4% air				
1:90	Ref off				
1:55	200sccm Reformate + 6% air				
2:45	Ref off				
2/3 7:40	5.71	0.5	80/550	30/60	80/106/90
7:48	SRG: 12.72	HFR: 0.105			OCV: 0.98
2/4 8:10	5.50	0.5	80/550	30/60	80/105/90
8:18	SRG: 12.68	HFR: 0.103			OCV: 0.98
2/5 8:21	5.07	0.5	80/550	30/60	80/105/90
8:33	SRG: 12.65,	HFR: 0.103			OCV: 0.98
9:25	Reformate @ 200sccm + 6% air				

Cont on Pg 148

TF385 Station 9-2 N105 / A: 0.14 mg Pt/cm²
4/24/98 C: 0.19 mg Pt/cm²
Backing: A: 0.53 mg Sn/cm²
C: Std Uncat. E-TEK

Date/Time	Cd	Vcell	FF	PSIG	Tc/Th/Th
4/27 8:00	6.0	0.5	160/550	43/66	80/105/90
8:10	SRG: 7.71,	HFR: 0.105		OCV: 0.97	
8:52	100 ppm CO				
9:51	CO off				
11:45	100 ppm CO + 2% air				
1:00	CO off				
2:15	100 ppm CO + 4% air				
3:14	CO off				
4/28 7:57	6.8	0.5	160/550	34/64	80/105/91
8:05	SRG: 7.74	HFR: 0.103		OCV: 0.99	
9:35	100 ppm CO + 6% air				
10:30	CO off				
2:50	Ref w/o CO				
4/29 8:12	6.8	0.5	80/550	16/60	80/105/90
8:20	SRG: 7.71,	HFR: 0.103		OCV: 0.99	
8:45	Ref. w/CO: 120, H_2: 80				
9:46	Ref off				
10:41	Ref w/CO + 2% air				
11:18	Ref + CO off				
12:55	Ref w/CO + 4% air				
1:55	Ref off				
2:55	Ref w/CO + 6% air				

Shut down. Removed from Station

TF389 (5cm²) M.A-2 N105 | A: 0.19 mg Pt/cm²
5/19/98 | C: 0.20 mg Pt/cm²
Backing: RCA 0.72 mg ~~Pt~~ Ta_2O_5/cm²
Uncat. E-TEK

date/time	Cd	Vcell	fr	PSIG	Tc/Tu/Tn
5/20 7:49	6.3	0.5	160/550	44/60	80/105/90
7:59	SRG: 7.70	HFR: 0.113			OCV: 0.97
5/21 7:43	6.7	0.5	160/550	44/70	80/105/90
7:53	SRG: 7.73	HFR: 0.113			OCV: 0.97
5/22 7:42	6.1	0.5	160/550	42/58	80/105/90
7:44	SRG: 7.70	HFR: 0.116			OCV: 0.97
5/26 8:03	5.4	0.5	160/550	45/65	80/105/90
8:26	SRG: 7.72	HFR: 0.115			OCV: 0.97
5/27 8:00	6.2	0.48	160/550	32/58	80/105/90
8:26	SRG: 7.78	HFR: 0.111			OCV: 0.97
5/28 8:20	6.5	0.48	160/550	33/62	80/105/90
8:28	SRG: 7.72	HFR: 0.111			OCV: 0.97
6/1 8:23	4.9	0.59	160/550	16/60	80/105/90
8:39	SRG: 7.66	HFR: 0.113			OCV: 0.97
	Volt set at 0.5 reading 0.59, pwr supply quit				
6/2 8:20	6.3	0.49	160/550	28/60	80/105/90
					OCV: 0.97
8:39	Chging Pwr supply on station				
9:12	Being back on line				
6/3 8:15	6.4	0.49	160/550	33/60	80/105/90
8:25	SRG: 7.72, HFR: 0.114				OCV: 0.97
6/4 8:50	6.0	0.50	160/550	33/60	80/105/90
8:57	SRG: 7.74	HFR: 0.113			OCV: 0.97
1:50	100 ppm CO				
3:05	CO off				
6/5 7:58	6.0	0.50	160/550	30/60	80/105/90
8:21	SRG: 7.77	HFR: 0.113			OCV: 0.97
9:00	pwr out - air compressor down				
9:40	compressor on				

cont. on pg 32

TF389 St. 4-2 Cont from pg 21

date/time	Cd	Vcell	Fr	PSIG	Tc/Tm/Tn
6/5 11:55	100ppm CO + 2% air				
12:47	CO off				
2:00	100 ppm CO + 4% air				
2:45	CO off				
6/8 8:15	4.7	0.5	160/550	30/62	80/105/9
8:32	SRG: 7.74	HFR: 0.118		OCV: 0.97	
6/9 8:14	4.2	0.5	160/550	30/60	80/105/9
8:25	SRG: 7.74	HFR: 0.118		OCV: 0.97	
6/10 8:07	4.4	0.5	160/550	32/60	80/105/90
8:22	SRG: 7.62	HFR: 0.116		OCV: 0.97	
6/11 8:18	5.6	0.5	160/550	30/60	80/105/90
3:00	100 ppm CO + 6% air			OCV: 0.97	
3:45	CO off	entered on wrong pg			
6/11 8:51	SRG: 7.72	HFR: 0.117			
9:30	Ref w/CO: 120, H_2: 80				
10:20	Ref off				
6/12 8:59	5.3	0.5	80/550	30/60	80/105/9
9:08	SRG: 7.66	HFR: 0.118		OCV: 0.97	
	Cd	Vcell	PSIG	Fr	Tc/Tm/
6/15 8:23	5.5	0.48	26/62	80/550	80/105/
	SRG: 7.75	HFR: 0.114		OCV: 0.97	
	Cd	Vcell	PSIG	Fr	Tc/Tm/
6/16 8:00	6.3	0.48	28/64	80/550	80/105/
	SRG 7.71	HFR 0.111		OCV 0.97	
8:55	Ref w/CO + 2% air				
10:40	CO off				
12:05	Ref w/CO + 4% air				
1:05	Ref w/CO off				
2:15	Ref w/CO + 6% air				
3:15	Ref off				

Cont on pg 41

Cont'd from p. 32

Test 389: st 4-2

date/time	Cd	Vcell	Fa	PSIg	Tc/Ta/Tc
6/17/8:00	6.0	0.49	~~80~~/550	34/62	80/105/90
	SRG: 7.53	HFR: 0.110		OCV: 0.97	
9:20	100ppm CO	H_2: ~~80~~ 79 sccm, 1% CO: 0.8 sccm			
10:24	CO off				
11:25	100ppm CO + 2% air				
12:18	CO off				
1:50	100ppm CO + 4% air				
3:00	CO off – Increased H_2 to 160 sccm				
6/18 8:04	4.1A Cd 0.39V	160/550	30/60	80/105/90	
	SRG 7.75	HFR 0.112		OCV 0.97	
10:45	100ppm CO				
11:35	CO off				
1:45	100ppm CO + 2% air				
1:55	CO off				
2:15	Shutting down to repair Station				
6/22	Station Repaired cell back on line				
6/23 8:13	6.4 ~~7.0~~ 0.5	160/550	35/55	80/105/90	
8:16	SRG: ~~7.34~~	HFR: 0.111		OCV: 0.99	
9:25	100ppm CO				
10:35	CO off				
12:50	100ppm CO + 2% air				
2:05	CO off				
3:00	CO + 4% air				
3:37	CO off				
4:33	100ppm CO + 6% air				
6/24 9:30	Computer crashed				
9:58	5.5	0.49	160/550	40/60	80/105/90
10:00	SRG: 7.69	HFR: 0.107		OCV: 0.97	
2:00	Ref w/ CO				
2:45	Ref off				

Cont on pg 55

TF389 / St. 4-2 cont from pg 41

date/time	Cell	Vcell	Qf	PSIG	Tc/Ta/Th
6/25 8:00	6.2	0.5	80/550	10/60	80/105/90

SRG: 7.7 HFR: 0.106 OCV: 0.97

9:05 Ref w/CO: 120; H_2: 80

9:45 Ref off

11:20 Ref w/CO + 2% air

1:10 Ref off

4:38 Ref w/CO: 120; H_2: 80 + 4% air (8 sccm)

6/26 8:30	4.4	0.5	80/550	10/60	80/105/90

SRG: 7.69 HFR = 0.105 OCV: 0.97

9:15 Ref w/CO + 6% air
(120/80 Hz/12.6 sccm Air)

10:09 Ref. w CO off. Back to neat H_2

11:30 Cell removed from station. All tests finished.

EXHIBIT F
INVENTION DISCLOSURE

LAD-99-88 October 1, 1999

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Access to this document is provided only on a NEED-TO-KNOW basis.

NOTE: That attached invention disclosure is considered Business Sensitive information and is distributed on a "need to know" basis. If this information is released to personnel who do not have a "need to know," the chances of receiving a patent are greatly jeopardized.

Important Information regarding this Invention Questionnaire (i.e., statutory bars, upcoming disclosures, etc.) is highlighted on the attached Disclosure Data Entry Form if applicable.

Cy:
Bill Eklund, LC/BPL, D412
Bruce Cottrell, LC/BPL, D412
Sue Potter, LC/BPL, D412
IP-File

Commercialization Action Teams
Disclosure Data Entry Form

Case Number: S-

LAD# 99-088 CAT Assignment: Materials

Title of Invention

FUEL CELL ANODE CONFIGURATION FOR CARBON MONOXIDE TOLERANCE USING NON-PRECIOUS CATALYSTS

MAM: 10/1/99 Case Attorney: CAT Patent Attorney: Milt Wyrick

109906

First Name	Last Name	Group	Mail Stop	Division	Phone	Record #	Z#
Franscisco A	Uribe	MST-11	D429	MST	(505)667-3964	845	109906
Thomas A	Zawodzinski	MST-11	D429	MST	(505)667-0925	401	103906

Others	Company

CAT Decision

- ☐ File
- ☐ Reject
- ☐ On-Hold
- ☐ Appeal
- ☐ Recommend to DOE

Rejected Because of:

- ☐ Existence of a Statutory Bar
- ☐ Lack of Patent Novelty Relative to Prior Art
- ☐ Lack of Identifiable Industrial Benefits
- ☐ Limited Commercial Potential Outside Govt. Use
- ☐ Insufficient Information for a Patent Application
- ☐ Lack of Response by Inventors w/CAT
- ☐ Undemonstrated Ability to "Reduce to Practice"

Disclosure Rec'd by IPM: 9/30/99 Date Referred to CAT: 9/30/99

Date LAD# Opened: 9/30/99 (note that dates 10/1/97+ reflect new royalty policy) CAT Decision Date:

Disclosure Sent to LC/BPL: 9/30/99 Case Attorney Notification Date:

Date Received S# from LC/BPL: Date LAD Closed:

Date PI(s) notified of decision: ◉ Not Reviewed ○ Reviewed

Comments:
9/30/99 - Sent disclosure to LC/BPL for patent review

B&R code: EE0204000

Development Stage:

Reduced to practice ◉ yes ◉ no

THIS DOCUMENT CONTAINS PRIVILEGED INFORMATION

DOE DOCKET NO.: S-_____ LAD-99-088

PLEASE DO NOT COMPLETE ANY INFORMATION ABOVE THIS LINE

UNIVERSITY OF CALIFORNIA
THE LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NM 87545

INVENTION DISCLOSURE

(consolidated Record of Invention and Invention Evaluation Questionnaire)

This invention was made in the course of or under prime Contract No. W-7405-ENG-36 between the U.S. Department of Energy and the Regents of the University of California. This Invention Questionnaire is an important legal document and should be fully and carefully prepared in accordance with the following instructions.

INSTRUCTIONS: 1) This Invention Disclosure will form the basis from which UC will determine whether to elect title to this invention and proceed to seek patent protection. It is important that you provide as much information as possible. 2) Please submit **completed** Disclosure to the Intellectual Property Management (IPM) team within the Civilian and Industrial Technologies Program Office (CIT-PO), MS C334. 3) The appropriate Group Leader(s) **must** sign the completed Disclosure before it is submitted for review.

If you have any questions, please call the Annabelle Torres at 667-8129 or Sharon Trujillo at 665-6708. IPM will coordinate the patent filing decision with Laboratory Counsel, Business and Patent Law (LC/BPL) and the appropriate Capability Access Team (CAT), and will contact you once this decision has been made. The answers to the following questions will be reviewed by the appropriate CAT and by LC/BPL. You may be contacted by LC/BPL or the CAT for additional information. Both will use this information to determine if a patent application will be filed on behalf of the University of California. Your answers should be in non-technical language as they will form the basis of this business decision.

Source of Funding (Program or Agency):

_DOE/OTT_____

☐ CRADA ☐ User Facility ☐ Technical Assistance
☐ Work For Others ☐ LDRD ☐ Other _____

DOE Program Director:_____JoAnn Milliken/Steve Chalk_____

DOE B&R Code:___ EE0204000 _____

Please provide input regarding the category this invention best represents.
(Refer to the Capability Access Team Reference Guide for further details)

Check only ONE: ☐☒ **Materials** ☐ **Computing** ☐ **Chemistry**

☐ Bioscienc ☐ Engin ering & Physical Science

Invention Information

1. **Title of Inv ntion** (indicate briefly the name of the article, device, material, composition, or process)

Fuel Cell Anode Configuration For Carbon Monoxide Tolerance Using Non-precious Catalysts.

2. **Discloser(s):** The list should include all individuals who are believed to have made an original contribution to the inventive concept and a substantial contribution to its reduction to practice. When in doubt, it is best to include a person rather than exclude a person. The final determination of inventorship will be made by LC/BPL after the invention is defined and after discussion with the disclosers listed below.

Name	MS	Phone	Home Address	Employer	Z#
Francisco A. Uribe	D429	7-3964	352 joya Loop Los Alamos NM 87544	LANL	109906
Thomas A. Zawodzinski Jr.	D429	7-0925	120 Sierra Vista Los Alamos NM 87544	LANL	103906

3. **Attach a description of the Invention.** Include as many pages and attachments as needed to fully describe your invention, and how it differs from the state of the art, including any experimental protocols and results. You should also attach copies of notebook pages and other written documents that are pertinent to the invention.

Suggested Format:

A. Brief non-technical abstract of the Invention
B. Background of the Invention, including a statement of the problem(s) to be overcome and previous attempts to solve these problems (include reference materials on the problem(s) and the attempted solution(s)).
C. Statement of Invention (what did you invent and what are the advantages)
D. Detailed description of the Invention (include drawings, photos, graphs, etc.) in sufficient technical detail for the reader to understand the invention.

4. **Dates and Places of Invention:**

a) **Conception of Invention:** 25 March 1997 at MST-11 (LANL)

(Give the earliest date on which, and the place where, the invention was suggested, even if not complete. If the invention includes several inventive concepts, give the conception date of each and clearly identify the contributor(s) of each element). (date) (where)

b) **First Sketch or Drawing:** 10 Sept. 1997 at MST-11 in Notebook Fuel Cell No. 2 Page 119
(Give the date of the earliest record that is available) (date) (place) (number)

c) **First Written Description:** 10 sept. 1997 at MST-11 in Notebook Fuel Cell No. 2 Page 119
(Give the date of the earliest record that is available) (date) (where) (number)

d) **Completion of Model or Full Size Device:** 1 Oct. 1997 at MST-11 (date) (where)

e) **First Test or Operation of Invention:** 2 Oct. 1997 at MST-11 (date) (where)

Degree of success attained (List successive dates if successive results are available)

2 Oct 1997, 15 Oct 97, 23 Oct. 1997 , 30 Oct. 1197 , 4 Nov. 1997, 10 Nov 1997 , 14 Nov. 1997 , 19 Nov. 1997 , 3 Dec. 1997, 21 Jan. 1998, 29 Jan. 1998 , 23 June 1998

5. a) **What is the present stage of development of this Invention?** (Please check one)

☐ Concept (A bare idea with sufficient thought to provide initial direction toward a reduction to practice)

☐ Bench Design (An initial test of a complete Invention using laboratory resources; not engineered)

☐ Lab Prototype (An engineered design that incorporates the complete Invention, but not engineered to use in its intended environment)

☐ Lab Testing (Sufficient testing to obtain proof-of-principle verification)

☐ **X** Field Prototype (An engineered design that may be used outside the laboratory in its intended environment)

☐ Ready for Transfer (An engineered and tested process or equipment with test results to demonstrate the capabilities of the Invention)

b) **Have you achieved "actual" reduction to practice?** (i.e. did you achieve the desired result -- operating machine, desired material, process control -- in accordance with the description of the Invention provided above)
Yes __X_____ No _____ If yes, what was the date? 2 Oct 1997

c) **For the stage of development checked above, what additional effort (tasks,**

tim , mon y) is ne d d to bring th Invention to th next stag ? (If not known, please provide your best estimate)

1. Implementation in stacks, lifetests are needed to bring invention to next stage on road to commercialization. Work done to date is sufficient for patent.

d) **If additional effort is needed, are you currently funded to advance the Invention to the next stage?**

Yes

6. a) **Disclosure of the Invention to Others (Include other UC/LANL staff):**

	Name/Organization	Date (MM/DD/YY)	Where Disclosure Was Made	Was This covered by a Proprietary Information Agreement (PIA)?
1.	DOE/OTT	3/18/98	Los Alamos, NM	
2.			(details not disclosed)	
3.				
4.				

b) **List all abstracts, documents, publications and presentations describing the Invention that you have published or prepared for publication, or presented on the subject.** Indicate whether each disclosure was internal (within the Government complex) or external (third parties with no obligation of non-disclosure and use). Also, indicate whether each disclosure was an oral presentation or written disclosure.

Title/Subject	**Publication/Date**	**Int./Ext.**	**Oral/Writt n**

PROPRIETARY INFORMATION
Dissemination or Disclosure Restricted (AM 721)

OAAT/DOE Program Review	18 March 1998	Int	written

c) **List related publications (by yourself or others)** Written materials that describe problems and/or features discussed in your description of the Invention and other inventions (including disclosures, patent applications, issued patents, journal articles, etc.) — attach copies if available. Also, provide a brief statement of how each item relates to the described Invention.

	Title/Subject	**Author(s)**	**Publication/Dat**
1.	Fuel Cell Anode Configuration For CO Tolerance and S. Gottesfeld . Patent Application, Jan 1999	F. Uribe, T. Zawodzinski, M.S. Wilson	
2.			
3.			
4.			

Relationship (recognition of an identified problem or description of a feature of the invention) to the described Invention (Refer to the publication number above i.e. 1,2,3,4)

This invention is also related to CO tolerance in fuel cells but uses non-precious metal catalysts.

7. **Are there other R&D efforts at LANL (by yourself or others) related to the subject matter of this Invention that may not be ready for Invention Questionnaires or patent applications to be filed?** If so, please provide the subject matter, PI name, and the approximate date disclosure is expected.

8. a) **Under what specific project(s) (CRADA, Work for Others, User Facility, DOE, DoD, T chnical Assistance, LDRD, tc.) did this Inv ntion aris ?**

b) **What are the plans for further development of this Invention (including funding)?** Is there or could there be interest from other federal agencies?
The invention will be the subject of tech transfer activities and will be of interest to other agencies.

c) **Will this Invention be used as a basis for starting a new project?** Yes ____ No _X_ Unsure ____ If not, is there a potential use of this Invention on other projects? Please explain.

9. **Will the government (e.g. DOE, DoD, or other Federal Agencies) purchase products or processes covered by the Invention?** Yes _____ No _____

If known, state actual or potential amount of procurement_____

10. **What commercial entities (non-government) might be interested in sponsoring further development of this Invention?**
Fuel Cell manufacturers or fuel cell materials manufactures (Plug Power, Gore, Energy Partners, IFC)

11. **Was the Invention funded by, or is it primarily useful in connection with government programs directed at: the storage of civilian radioactive wast ; uranium enrichment; United States Advanced Battery Consortium; DOE Steel or Metals Initiative; or, is it subject to an international agreement or funded by EPRI or GRI?**
Yes _____ No ___X__ If yes, provide details.

12. a) **Are you aware of any physical, environmental, safety, or regulatory risks with regard to this Invention?** Yes _____ No __X___ If yes, please describe the risks. List existing regulations which could impede implementation of this Invention.

b) **Are you aware of any political or public sensitivities with regard to this Invention or any related technologies?** Yes _____ No _X__ If yes, please describe the nature of the sensitivities.

Commercial Potential

13. **Please fill out the attached table (Appendix A) as completely as possible.** (Instructions are provided in Appendix A)

14. **Are you interested in commercializing this Invention yourself (in a non-LANL capacity)?** Yes _____ No X__ If Yes, please provide comments:

15. a) **What is unique, new or unexpected about this Invention?** (i.e. new or enhanced operation or performance, superior or unusual properties, decreased cost of operation, other reasons (i.e. existing technology is not adequate, etc.))

Enhanced performance of fuel cells operating on reformate fuels. The use of non-precious metals as catalysts decreases cost of parts by 2 or 3 orders of magnitude.

b) **How will the answers in 15a provide an industrial partner comp titive advantag ?** (i.e. what will make people want to use this technology instead of what is already available?)

This invention provides a simple and inexpensive solution to a difficult problem. Fuel cells fed with reformate fuels (containing 20 to 100 ppm CO) won't operate unless something is done to avoid catalyst poisoning. So far the only viable solution is to increase the amounts of catalysts (precious metals) to prohibited costs.

16. **Are there barriers to implementing this technology that a potential industrial user should know about?**

No

17. **Please summarize any comments (positive and negative) you have received, with regards to this Invention, from non-government parties.**

Several parties are interested in licensing it based on hearsay about our results.

18. **Have any commercial entities expressed an interest in this technology?** (If the company's interest in this Invention was for government use only, please state)

Yes X No _____ If Yes, please list the companies and describe their interest.

Plug Power , Gore

19. **This Invention Questionnaire was completed by:**

Francisco A. Uribe ___TSM___ 3/9/1999
Name **Position/Title** **Date**

Thomas A. Zawodzinski Jr. TSM_____ _3/9/1999
Name **Position/Title** **Date**

Discloser(s)/Line Manager Signature(s)

20. **Each discloser needs to sign and date the Invention Questionnaire.** If license income is generated as a result of this Invention, a portion of the income is returned to the division. Therefore, it is necessary to identify the Division to which the discloser(s) was(were) assigned at the time that 1) the Invention was conceived or first reduced to practice, 2) the software or other copyrighted work was authored, or 3) the mask work was created.

The line manager of the discloser(s) must review the Invention Questionnaire and sign-off indicating that he/she believes the technology to be sound and recommends that the University of California should seek patent protection.

I/We have reviewed this Invention Questionnaire and recommend that it be considered for a patent application:

SIGNATURES	Date	Group	Identified Division
Discloser Signature: Francisco A. Uribe	9/24/99	MST-11	MST
Discloser's Line Manager Signature:	9/24/99	MST-11	
Discloser Signature:	9/24/99	MST-11	

PROPRIETARY INFORMATION
Dissemination or Disclosure Restricted (AM 721)

Discloser's Line Manag r Signature:	9/24/99	MST-11	
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Discloser Signature:			
Discloser's Line Manager Signature:			
Discloser Signature:			
Discloser's Line Manager Signature:			
Discloser Signature:			
Discloser's Line Manager Signature:			

Witness Signature

21. **The witness must be a person who is not one of the discloser(s) but who has read the Invention Questionnaire and understands the Invention.**

Witness Name **Position/Title** **Date**

Line Manager Comments (Please feel free to provide any comments relevant to this Invention)

Appendix A: Technology Comparison Matrix

Instructions for filling out the table: (Response to Question 13 of the Invention Questionnaire)

- What are the PRIMARY commercial (non-government) uses or applications (foreign or domestic) for this Invention?
- What are the closest related technologies that are currently used for these applications?
- Which industry uses existing technology or is a potential user of this Invention for these specific applications?
- Are there any OTHER uses or applications, besides what is listed as primary (be creative, but realistic)? Include the same information (closest related technologies, industry sectors/markets).

	This Invention	Closest Related Technologies	Markets in which this Application May Be Applied
Primary Application(s)			
Other Applications			